MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2016/2017

ETM 7156 – MOBILE WIRELESS COMMUNICATIONS

(All sections/Groups)

3 JUNE 2017
9.00 a.m - 12.00 p.m
(3 Hours)

INSTRUCTIONS TO STUDENTS

1. This examination paper consists of 8 pages including cover page with 5 Questions only.

2. Attempt **ALL** the questions. Each question carry equal marks and distribution of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided. Please number your answers clearly.

4. Appendix is provided.

Question 1

(a) If a transmitter produces 75 W of power is applied to a unity gain antenna where system loss factor, L=1 with a 900 MHz carrier frequency,

(i) express the transmit power in units of dB and dBm.

[2 marks]

(ii) find the received power in dBm at a free space distance of 100 m from the antenna.

[4 marks]

(iii) find the received power at a distance of 10km.

[2 marks]

(b) In an open area environment at a distance of d=50km and a carrier frequency of 900 MHz. By referring to Figure 1 and using the Okumura model, find the following;

(i) free space propagation loss, L_F

[2 marks]

(ii) median attenuation relative to free space, A_{MU}

[2 marks]

(iii) gain due to the type of environment, G_{AREA}

[2 marks]

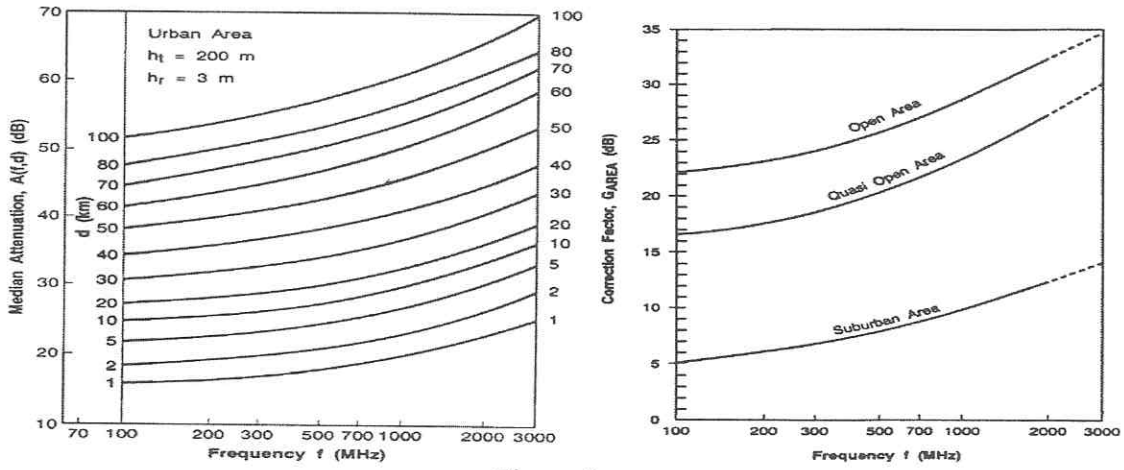


Figure 1

(c) Describe about fading in in term of signal and propagation.

[6 marks]

Continued .....

Question 2

(a) Assume a signal-to-noise ratio of 15 dB is required for satisfactory forward channel performance in a cellular system. Determine the frequency reuse factor and cluster size that should be used for maximum capacity if the path loss exponent, n is

(i) n=4

[4 marks]

(ii) n=3

[4 marks]

Assume that there are six co-channel cells in the first tier and all of them are at the same distance from the mobile. Use suitable approximations.

(b) An urban area has a population of 2 million residents. Two competing trunked mobile networks A and B provide cellular service in this area. Network A has 394 cells with 19 channels each, network B has 98 cells with 57 channels each.

(i) Find the number of users that can be supported at 2% blocking if each user makes on average 2 calls per hour with a call duration of 3 minutes each.

[6 marks]

(ii) Assume that all the trunked networks are operated at maximum capacity, find the percentage market penetration of each cellular provider.

[2 marks]

(c) For efficient utilization of the radio spectrum, a frequency reuse scheme that is consistent with the objective of increasing capacity and minimizing interference is required. Describe two methods of channel assignment for achieve these objectives.

[4 marks]

Continued .....

Question 3

(a) (i) An analog signal has a bit rate of 8000 bps and a baud rate of 1000 baud. Determine the data elements (bits) are carried by each signal element (baud) and number of signal elements required. Comment your answer.

[4 marks]

(ii) Assume we have an available bandwidth of 100 kHz spanning from 200 to 300 kHz. What are the carrier frequency and the bit rate if we modulate our data by using amplitude shift keyin, ASK with factor, $d = 1$?

[3 marks]

(iii) Find the bandwidth for a signal transmitting at 12 Mbps using quadrature phase shift keyin (QPSK). The value of factor, $d = 0$.

[3 marks]

(b) Draw the constellation diagrams for amplitude shift keyin (ASK), binary shift keyin (BPSK), and quadrature phase shift keyin (QPSK) signals. Identify number of signal elements required for each modulation scheme.

[3 marks]

(c) Draw a diagram to differentiate between Coded orthogonal frequency division multiplexing (COFDM) and Vector orthogonal frequency division multiplexing (VOFDM). Shows the signal path for each diagram.

[4 marks]

(d) State THREE(3) benefits of using direct-sequence spread spectrum (DSSS).

[3 marks]

Continued .....

Questions 4

(a) Assume 4-branch space diversity is used, where each branch receives an independent rayleigh fading signal. If the average signal noise ratio (SNR) is 30dB, find the probability that the SNR will drop below 3dB. Compare this with the case of a single receiver without diversity.

[6 marks]

(b) Assume there is a design of digital cellular equalizer with frequency, f = 900MHz, the mobile velocity, v = 80km/hr and the symbol rate is 1200 ksymbol/sec, find the following:

(i) Maximum Doppler shift

[2 marks]

(ii) Coherence time of the channel

[2 marks]

(iii) The maximum number of symbols that could be transmitted without updating the equalizer

[2 marks]

(c) Briefly describe four categories of space diversity combined methods.

[8 marks]

Continued .....

Questions 5

(a) The global system mobile (GSM) uses a frame structure where each frame consists of eight time slots, and each time slot contains 156.25 bits, and data is transmitted at 270.833 kbps. Determine the following;

(i) Time duration of a bit

[2 marks]

(ii) Time duration of a slot

[2 marks]

(iii) Time duration of a frame

[2 marks]

(iv) Duration of a user occupying a single slot to wait between successive transmissions.

[2 marks]

(b) Time division multiple access (TDMA) systems divide the radio spectrum into time slots, and in each slot only one user is allowed to either transmit or receive signals. State FOUR(4) features of a TDMA system.

[8 marks]

(c) The GSM system is a time division multiple access/time division duplex (TDMA/TDD) system that uses 25 MHz for the forward link, which is broken into radio channels of 200 kHz. If 8 speech channels are supported on a single radio channel, and if no guard band is assumed, determine the number of simultaneous users that can be accommodated by GSM.

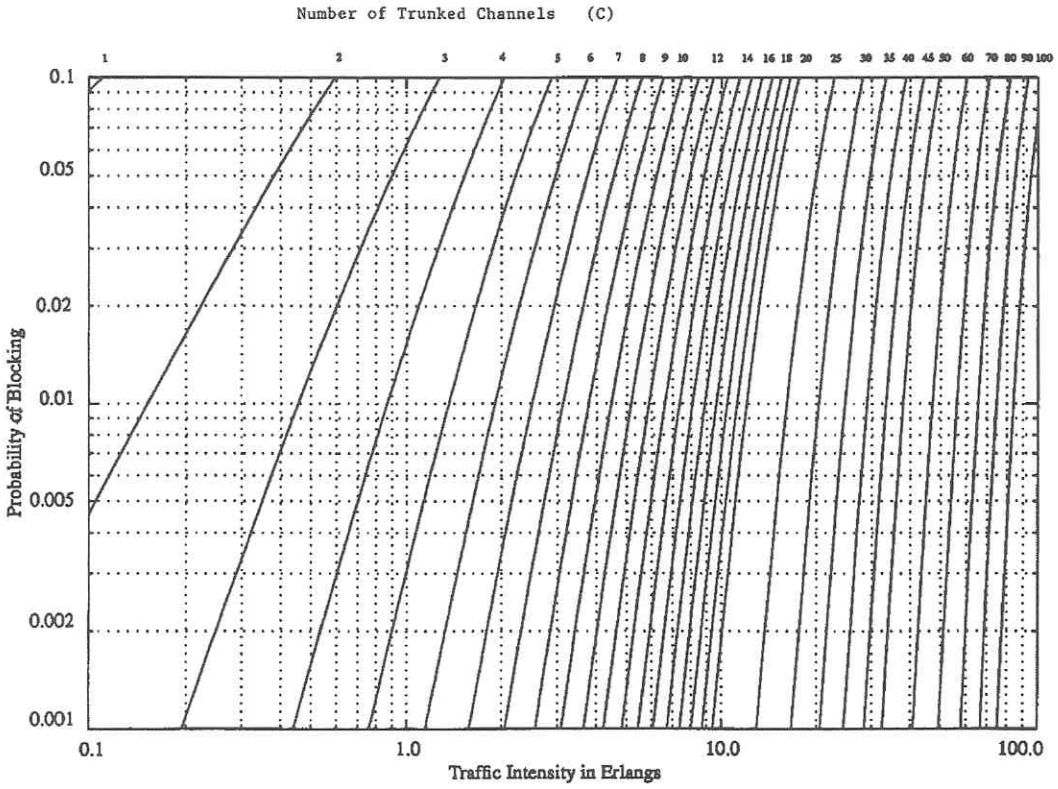
[2 marks]

(d) List down FOUR (4) different 3G standards defined by International Mobile Telecommunications-2000 (IMT-2000).

[2 marks]

End of Paper

Appendix 1: Erlang B Table



Appendix 2: Erlang C Table